AGROSTIS ELLIOTTIANA (GRAMINEAE) NEW TO ARIZONA AND NEW MEXICO

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On 9 April 1986 we collected a small annual species of *Agrostis* growing in moist sand along Ash Creek on the eastern edge of the Rincon Mts., Pima County, Arizona. *Agrostis scabra* Willd., a perennial, is common along this small stream, and the little annual could easily be overlooked or mistaken for young plants of the perennial. Careful examination, however, revealed that the lemma of the annual bears from below the apex a fine flexuous awn which averages 5—7 (-8) mm in length; in *A. scabra* the lemmas are awnless, or essentially so.

We have determined this annual grass as *Agrostis Elliottiana* Schultes, which seems to be the first record from Arizona. The species was originally described as *A. arachnoides* by Elliott (Bot. S.C. & Ga., 1816) based on plants from South Carolina. Later this name was recognized to be a homonym of *A. arachnoides* Poir. (1810) by Schultes (Mantissa, 1824), who named the plant in honor of its original author.

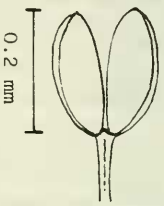
In his monograph of *Agrostis,* Hitchcock (1905) cited collections of *A. Elliottiana* from South Carolina, Georgia, Alabama, Tennessee, Illinois, Missouri, Arkansas, Mississippi, Louisiana, and Texas. It is now known from all of the Southeastern States, and is reported as having been introduced into Maine and Massachusetts, as well as Yucatan, Mexico.

Descriptions of this delicate annual are many, often quite detailed, and give a good idea of the essential characteristics of the species. Emphasis is usually directed to the open, diffuse panicle in which the slender whorled branches are naked below, branched, bearing spikelets on the outer 1/3 to 1/2. The spikelet consists of two subequal glumes 1.5—2 mm long; the conspicuously 5-nerved lemma is 1.2—1.7 (-2) mm with a slender flexuous awn up to 8 (-10) mm long borne below the tip (or rarely awnless). The awn is variously described as flexuous and "scabrous" or "delicately short pilose" (Hitchcock, 1937). Small (Flora SE United States, 1903) described it as "a very finely filiform flexuous barbellate awn." The palea is wanting or a mere scale.

Our Arizona plants fit the description in all details, and reveal yet another interesting character: the presence of only one tiny stamen (ca. 0.2 mm long). There seems to be no recognition of this character in the recent literature. In fact, generic descriptions of *Agrostis*, if the matter is stated at all, indicate stamens 3 (cf. Björkman, 1960; Philipson, 1937). If one checks earlier literature, however, he will find that Kunth (Rev. Gram., 1829) in describing the genus gives "stamina 1--3." Bentham & Hooker (Gen. Pl., 1883) cited "stamina saepius 3." Kunth (Enum. Pl., 1833)

stated for *Agrostis arachnoides* Elliott [= *A. Elliottiana*]: "anthera subunica." Trinius (1841), however, when describing the same species gives: "Stamina 3. Antherae lineares," even though in his generic description he indicates: "Stamina 1—3." A check of the 76 species enumerated in this work shows most have three stamens; only four species are said to have but one. These include *A. exarata* Trin. and *A. geminata* Trin. In fact, Trinius (Sp. Gram. Icon., 1823—1836) illustrated these two species showing a single stamen; most of the other taxa shown have three. In our examination of numerous specimens of these two species, we consistently found three stamens per spikelet. Often a solitary anther remains attached to the top of the floret after anthesis, which may explain the report of a single stamen.

The tiny stamen in our Arizona specimens is visible to one side of the small ovary with its two stigmas. Below are two typical pooid lodicules which are broadly lanceolate with no vascular traces. The stamen is unusual in that it appears to be two largely separate anthers attached to the apex of a single filament. Normally, stamens in grasses consist of a filament bearing an anther with four pollen sacs. Since each of the two apparent "anthers" of our little grass is comprised of two pollen sacs, it seems reasonable to conclude that each is a half-anther. Moreover, there is a single vascular bundle in the filament, which seems clearly to indicate that the androecium is, indeed, a single stamen. The dehisced stamen remains within the floret at the apex of the mature caryopsis, indicating a probable cleistogamous condition.



stamen

In any treatment of *Agrostis* which includes both species, one finds *A. exigua* Thurber (1880) listed as a close relative of *A. Elliottiana*. The area in which we found our plants in Arizona is roughly midway in distance between the easternmost recorded range for *A. Elliottiana* and the localities for *A. exigua* in California. It seemed prudent, therefore, to consider that our plants might represent this latter taxon, or alternatively that the two species could be synonyms. In checking Thurber's original description of *A. exigua* we noted with considerable interest: ". . . upper palet not manifest or a mere scale; stamens 1 (?)." His description is ample, but did not appear to be greatly different from those we had found for *A. Elliottiana*. Thurber's description clearly states: "Panicle half the length of the plant, included and at first narrow, at length open . . ." The illustration in Hitchcock (1905) and in Hitchcock's Manual (1951) is of a small apparently immature plant with a narrow, contracted panicle! In the 1905 study, he separates the two species in a very simplistic fashion:

"Awn straight. California. 9. *exigua*
Awn flexuous. Southeastern States. 10. *elliottiana*."

In this same treatise, he quoted the entire original description of

A. exigua, but did add some further notes. At the time (1905) the species was represented only by the type (*Bolander s.n.*). Hitchcock commented: "It is unusual to have a species so rare as is indicated by a single collection in a region so well known as California, and I suspect that the species is either introduced or occurs farther to the south in Mexico or Central America, the species of which region are not sufficiently well known." In the same work, Hitchcock added this note: "Mr. Thurber at first referred this to *A. elliottiana*, which it resembles in habit. But it differs from that species in having the flowering glumes as long as the empty glumes, the lobes extending into two awned teeth, and in the stouter straight awn. The empty glumes are only slightly acute, 1.5 mm long, equal, slightly scabrous on back. Awn scabrous, straight, 5—6 mm long."

In order to determine the validity of the differences stated above, we borrowed all of the specimens of *Agrostis exigua* from UC. There were only eight, all from California. In comparing these specimens with material of *A. Elliottiana* at ARIZ, which represented collections from Virginia to Oklahoma and eastern Texas, we could find no differences to suggest that more than one taxon is represented.

The length of lemma to glumes varies from plant to plant. In some, the lemma appears to be about as long as the glume, whereas in others the lemmas are slightly shorter. This difference is not confined to plants from any specific geographic area; both conditions were observed among the California plants as well as those from the Southeast. No significant differences in conformation nor indument were detected. The length of setae at the apex of the lemma varies within the same collection. Mostly they are 0—0.1—0.2 mm, but rarely attain a length of 0.3—0.4 mm. They are usually quite inconspicuous, and often can be detected only under high magnification. Although prominent setae have been used as a character to distinguish *Agrostis exigua* from *A. Elliottiana*, we did not find this feature to be dependable. In some of the California collections, the longest setae scarcely attain a length of 0.1 mm, while setae 0.2 mm long were observed in plants from Louisiana and eastern Texas. Whereas lemma setae appear to average slightly longer on the California plants, we did not find presence or absence of setae to have any validity in segregating these taxa.

In both the Southeastern and California collections, the panicle consists of about half the plant height, with capillary branches which divide and bear spikelets on the outer 1/3 to 1/2. In Hitchcock's Manual (1951), *Agrostis exigua* is described as a delicate annual 3—10 cm tall. *Hoover 5872* (UC) from Shasta County, CA, consists of seven plants all with open panicles. The largest specimen is 45 cm tall, and the lowest panicle branches measure as much as 7.5 cm in length! The plants comprising *Tracy 18671* (UC) from Napa County, are rather similar to the above with a maximum height of 23 cm.

Although the awn of *Agrostis Elliottiana* is described in the literature as slender and flexuous, that of *A. exigua* is said to be "straight" (Hitchcock, 1937) in the key and "straight or flexuous" in the text! In the 1951 Hitchcock's Manual *A. exigua* is keyed with the brief statement: "Awn geniculate; Pacific Coast." In the same publication the awn of *A. Elliottiana* is described as ". . . very slender, flexuous, delicately short pilose, 5—10 mm long." Among the California specimens examined, we did note that awns tended to be slightly less slender and delicate than those from the Southeast. Perhaps because they are less "threadlike," they may appear to be somewhat straight rather than prominently sinuous. Numerous awns on the "*A. exigua*" specimens are flexuous, however, and as noted above, Hitchcock (1937) described them as "straight or flexuous." Moreover, Hoover noted on the label of his *#2261* from Tehama County, CA: "awn... delicate, straight or flexuous (not geniculate)." In view of the fact that awnless forms of *Agrostis Elliottiana* occur, the slight awn differences mentioned above are probably of minor taxonomic significance. We found the awns of both "species" to have rather widely spaced longer than usual spicules (or 'prickle hairs' sensu Metcalfe). With a hand lens these spicules may give the appearance of short hairs, but under high magnification they are clearly somewhat elongated spicules.

The presence of one stamen within the floret is obviously a crucial character, if these "species" are indeed the same. The California specimens all proved to have a single stamen, as had been suggested by Thurber in his original description. It is identical to those we found in the Arizona plants and in material from the Southeastern United States.

In 1825 Rafinesque (Neogenyt. 4) proposed the genus *Notonema,* based on *Agrostis arachnoides* Elliott [= *A. Elliottiana*], citing the presence of a single stamen as sufficient reason to segregate it as a monotypic genus. In 1830 (Seringe Bull. Bot. 1: 220) he described the genus, which was only a nom. nud. in the 1825 publication. (Cf. Merrill, E. D. 1949. Index Rafinesquianus. p. 76). However, the transfer of the specific epithet was not published until Jackson included it in Index Kewensis 2: 319. 1894: *Notonema arachnoides* (Elliott) Raf. ex Jackson. No one since that time has adopted Rafinesque's genus probably because these plants so closely resemble such undisputed members of *Agrostis* as *A. hyemalis* (Walt.) B.S.P. and/or *A. scabra* Willd. This is especially true for the rather rare awnless form of *A. Elliottiana.* Gleason (in Britton & Brown, 1952) has added this note to the *A. Elliottiana* description: "Awnless forms, rarely seen in our range, may be distinguished from *A. hyemalis* by the proportionately larger panicle and sharply nerved lemma and the annual habit." Two years later Shinners (Rhodora 56: 28. 1954) published forma *molesta* for the awnless plants and commented on the difficulty of separating them from *A. hyemalis.* To the differences enumerated by Gleason, we would add that in *A. Elliottiana* the capillary panicle branches are minutely scaberulous, and there is only one tiny stamen per floret.

While in the process of studying our Arizona collections, we received a specimen from R. D. Worthington (UTEP). His material from westernmost New Mexico had been identified as *Agrostis exigua* by Stephan Hatch (TAES), and verified by botanists at UC. We found the Worthington specimen (new to New Mexico) in general to be a good match for our Arizona collections. One difference is that some lemmas of the New Mexico plants have unusually long setae (up to 0.4 mm). In the same inflorescence, however, one can find lemmas with setae 0.25 mm or less. It is noteworthy, we believe, that in our Arizona material, collected some 160 km farther west, and thus nearer to the "homeland" of *A. exigua*, the maximum length of lemma setae is 0.2 mm, whereas on many of the lemmas setae appear to be lacking or are less than 0.1 mm long. Another almost imperceptible difference is that the awns on the New Mexico plants seem to be slightly more delicate and, perforce, a bit more flexuous than is the case with our Arizona gatherings.

For cytological studies, we fixed young inflorescences from populations of our *7830* and *7841* in the field in the standard 3:1 absolute ethyl alcohol: acetic acid mixture. Because the anthers are so tiny (only 0.2 mm when mature) it is essentially impossible to prepare squashes in the usual manner. We resorted to using entire flowers, often with a bit of lemma attached. This species appears to be diploid with $2n = 14$ chromosomes. Seven pairs were observed in dividing PMC's, and we also counted 14 somatic chromosomes in mitotic divisions in the stigma. As nearly as we have been able to determine, this is a first count for *Agrostis Elliottiana*. We found no report in the literature for either this species or *A. exigua*.

Under close scrutiny, we find the supposed differences between these two "species" to be more apparent than real. Our conclusion, therefore, is that a more realistic taxonomy results when *Agrostis exigua* is treated as a synonym of *A. Elliottiana*. The Arizona and New Mexico collections reported here, which are new records for these states, serve to bridge the gap, both morphologically and geographically, between the eastern and western populations, and extend the range of *A. Elliottiana* from coast to coast in the USA.

Agrostis Elliottiana Schultes, Mantissa 2: 202. 1824. Based on *A. arachnoides* Elliott.

Agrostis arachnoides Elliott, Bot. S.C. & Ga. 1: 134. 1816; non Poir. 1810. Type: South Carolina, Orangeburg. *Bennett.*

Agrostis exigua Thurber in S. Watson, Bot. Calif. 2: 275. 1880. Type: California, foothills of Sierras, *Bolander s.n.*

Notonema arachnoides Raf. (Neogenyt. 4. 1825) ex Jackson, Index Kew. 2: 319. 1894. Based on *Agrostis arachnoides* Elliott.

Notonema agrostoides Raf. ex Merrill, Index Rafinesq. 76. 1949. Error for *N. arachnoides*.

Agrostis Elliottiana Schultes forma *molesta* Shinners, Rhodora 56: 28. 1954. [for the awnless form.] Type: Texas, Wood Co., Mineola, *Shinners 14372*.

SPECIMENS EXAMINED

VIRGINIA: Aurora Hills, Alexandria, *Swallen & Hotchkiss, Amer. Gr. Nat. Herb. 1546* (ARIZ-2 sheets). **SOUTH CAROLINA**: Lancaster Co., Forty Acre Rock, *Leonard & Radford 1379* (ARIZ). [This collection has awned and awnless plants of *A. Elliottiana*, along with several immature specimens of young *A. hyemalis* (Walt.) B.S.P.]. **LOUISIANA**: Morehouse Parish, Bayou Bartholomew, west of Jones, *R. D. Thomas 18293* (ARIZ). **OKLAHOMA**: Muskogee Co., east of Bragg, *L. W. Myers 65* (ARIZ); Norman, Golf Links, *C. W. Prier s.n.* (ARIZ-84315). **TEXAS**: Dallas Co., near Seagoville, *Lundell & Lundell 10396* (ARIZ). [determined originally as *A. hyemalis* (Walt.) B.S.P.]; Brazos Co., Range Science Area, Texas A & M University, *J. Váldez R. s.n.* (ARIZ-249970). **NEW MEXICO**: Hidalgo Co., Peloncillo Mts., Cloverdale Creek Canyon, *R. D. Worthington 14015* (ARIZ). **ARIZONA**: Pima Co., Rincon Mts., Ash Creek, *Reeder & Reeder 7830, 7842, 7849* (ARIZ). **CALIFORNIA**: Shasta Co., Redding, *J. W. Blankenship s.n.* (JEPS-68390); 7 miles N of Redding, *R. F. Hoover 5872* (UC). Tehama Co., 4 miles S of Cottonwood, *R. F. Hoover 2261* (UC). Amador Co., S of Ione, *H. S. Yates 5138* (UC). Napa Co., Howell Mt., E of Angwin's, *J. P. Tracy 1552* (UC), *12109* (UC); La Jota Plateau, head of Moore's Creek, E of Angwin's, *J. P. Tracy 12462* (UC), *18671* (UC).

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IMPORTANT GENERAL LITERATURE

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Hitchcock, A. S. 1905. North American species of *Agrostis*. U.S. Dept. Agric. Bur. Plant Industry Bull. 68.

_____ 1937. *Agrostis* L. North Amer. Flora 17(7): 515—534.

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